L Number	Hits	Search Text	DB	Time stamp
-	2	("4829531").PN.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/14 10:17
-	2	("4829531").PN.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 16:31
-	2	("5488678").PN.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 16:35
-	2	("5825952").PN.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 16:33
-	0	jp-04449242$-$.did.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 16:36
-	1	jp-04249442$-$.did.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 16:39
-	0	jp-02511591$-$.did.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 16:38
-	7	"511591"	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 16:38
-	5296	(372/43).CCLS.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 17:12
-	876	(372/44).CCLS.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 17:12
-	3317	(372/45).CCLS.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 17:12
-	2608	(372/46).CCLS.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 17:12
-	122	(372/47).CCLS.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 17:12

-	415	(372/48).CCLS.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 17:12
-	601	(372/49).CCLS.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 17:12
-	1634	(372/50).CCLS.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 17:12
-	12010	((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 17:13
-	0	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and mold$2 near4 resin and diffusion adj plate	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 17:14
-	0	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and mold$2 near12 resin near12 diffusion near12 plate	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 17:15
-	0	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and mold$2 near12 resin near12 diffusion	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 17:16
-	8	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and mold$2 near12 resin and light near12 diffus$3	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 17:17
-	58	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and mold$2 near12 resin	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 18:35
-	0	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and spot adj size near12 resin near12 refractive adj index	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 18:36
-	0	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and spot adj size near12 resin	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/10/31 18:36
-	1	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and (beam adj size or beam adj diameter or spot adj size) near12 resin	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 11:14
-	305	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and (beam adj size or beam adj diameter or spot adj size)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 11:16

-	305	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and (beam adj size or beam adj diameter or spot adj size)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 11:23
-	0	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and (beam adj size or beam adj diameter or spot adj size) near4 ".mu.m"	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 11:24
-	0	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and (beam adj size or beam adj diameter or spot adj size) near12 ".mu.m"	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 11:24
-	0	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and (beam adj size or beam adj diameter or spot adj size) near12 $1".mu.m"	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 11:25
-	0	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and (beam adj size or beam adj diameter or spot adj size) near12 "8.mu.m"	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 11:26
-	0	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and (beam adj size or beam adj diameter or spot adj size) near12 "9.mu.m"	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 11:26
-	0	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and (beam adj size or beam adj diameter or spot adj size) near12 "10.mu.m"	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 11:27
-	43	(((372/43).CCLS.) or ((372/44).CCLS.) or ((372/45).CCLS.) or ((372/46).CCLS.) or ((372/47).CCLS.) or ((372/48).CCLS.) or ((372/49).CCLS.) or ((372/50).CCLS.)) and (beam adj size or beam adj diameter or spot adj size) near12 (larger or greater)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 11:29
-	4	"6111283"	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 13:42
-	2	("5502320").PN.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 13:42
-	2	("5986304").PN.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 13:43
-	2	("6111283").PN.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 13:43

-	173	laser.ti. and 372/43.ccls. and (mqw or multiple adj quantum adj well)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 14:29
-	33	laser.ti. and 372/43.ccls. and (mqw or multiple adj quantum adj well) and high adj power	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 14:29
-	0	laser.ti. and 372/43.ccls. and (mqw or multiple adj quantum adj well) and high adj power near12 resin	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 14:30
-	3	laser.ti. and 372/43.ccls. and (mqw or multiple adj quantum adj well) and high adj power and spot adj size	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 15:22
-	6	laser.ti. and 372/43.ccls. and ((second or additional or plurality) adj laser adj (chip or die))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 16:26
-	0	laser.ti. and 372/43.ccls. and molded adj resin near15 epoxy near15 silica	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 16:28
-	1	laser.ti. and 372/43.ccls. and epoxy near15 silica near15 resin	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 16:28
-	1	laser.ti. and 372/43.ccls. and epoxy same silica same resin	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 16:29
-	0	laser.ti. and 372/43.ccls. and resin near15 mixture near15 (silica or epoxy)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 16:30
-	1	372/43.ccls. and resin near15 mixture near15 (silica or epoxy)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 16:32
-	2742	resin near6 silica near6 epoxy	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 16:34
-	6327	molded adj resin near (resin near6 silica near6 epoxy) epoxy near15 silica	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 16:34
-	109	molded adj resin near (resin near6 silica near6 epoxy) epoxy near15 silica and laser.ti,ab.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 16:34
-	7	molded adj resin near (resin near6 silica near6 epoxy) (mixture or mixed) near15 epoxy near15 silica and laser.ti,ab.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 17:38

-	7	(seal or molded) adj resin near (resin near6 silica near6 epoxy) (mixture or mixed) near15 epoxy near15 silica and laser.ti,ab.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 17:39
-	29	(seal or molded) near3 resin near (resin near6 silica near6 epoxy) (mixture or mixed) near15 epoxy near15 silica and laser.ti,ab.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 18:08
-	20	jp-0818163$-$.did.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 18:09
-	0	jp-0818163$-$.did. and double adj sealing	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 18:09
-	116	double adj sealing and resin	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 18:09
-	23	double adj sealing near12 resin	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 18:24
-	1977	(mixing or mix or mixture) near12 resin and (light adj emitting or light-emitting or laser).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 18:26
-	14	(mixing or mix or mixture) near12 resin near12 refractive adj index and (light adj emitting or light-emitting or laser).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 19:06
-	19	(thermal adj resistance or heat adj capacity) near15 (chip or die) and laser.ti,ab,clm. and (372/$6.ccls. or 257/$6.ccls.)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 19:22
-	0	(thermal adj resistance or heat adj capacity) near15 (chip or die) and heat adj sink near15 (contain or container) and laser.ti,ab,clm. and (372/$6.ccls. or 257/$6.ccls.)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 19:24
-	0	(thermal adj resistance or heat adj capacity) near15 (chip or die) and heat adj sink near15 (contain or container) and laser.ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 19:24
-	26	(thermal adj resistance or heat adj capacity) near15 (chip or die) and heat adj sink near15 (contain or container)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/01 19:25
-	170	(372/4$1.ccls. or 372/50.ccls.) and thermal adj resistance	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 10:34
-	2	(372/4$1.ccls. or 372/50.ccls.) and (thermal adj resistance near15 "deg/W")	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 10:37

–	2	(372/4$1.ccls. or 372/50.ccls.) and "deg/W"	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 10:37
–	2	(372/4$1.ccls. or 372/50.ccls. or 257/79.ccls. or 257/8$1.ccls. or 257/9$1.ccls. or 257/100.ccls. or 257/101.ccls. or 257/102.ccls. or 257/103.ccls.) and "deg/W"	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 10:40
–	3654	(372/4$1.ccls. or 372/50.ccls. or 257/79.ccls. or 257/8$1.ccls. or 257/9$1.ccls. or 257/100.ccls. or 257/101.ccls. or 257/102.ccls. or 257/103.ccls.) and ("deg/W" or (thermal resistance near12 heat sink))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 10:41
–	2868	(372/4$1.ccls. or 372/50.ccls. or 257/79.ccls. or 257/8$1.ccls. or 257/9$1.ccls. or 257/100.ccls. or 257/101.ccls. or 257/102.ccls. or 257/103.ccls.) and ("deg/W" or (thermal resistance near12 heat adj sink))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 10:42
–	2867	(372/4$1.ccls. or 372/50.ccls. or 257/79.ccls. or 257/8$1.ccls. or 257/9$1.ccls. or 257/100.ccls. or 257/101.ccls. or 257/102.ccls. or 257/103.ccls.) and ("deg/W" or (thermal resistance near6 heat adj sink))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 10:43
–	365	(372/4$1.ccls. or 372/50.ccls. or 257/79.ccls. or 257/8$1.ccls. or 257/9$1.ccls. or 257/100.ccls. or 257/101.ccls. or 257/102.ccls. or 257/103.ccls.) and ("deg/W" or (low near6 thermal resistance near6 heat adj sink))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 10:43
–	2	(372/4$1.ccls. or 372/50.ccls. or 257/79.ccls. or 257/8$1.ccls. or 257/9$1.ccls. or 257/100.ccls. or 257/101.ccls. or 257/102.ccls. or 257/103.ccls.) and ("deg/W" or (low near6 thermal near6 resistance near6 heat adj sink))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 10:44
–	1	(372/4$1.ccls. or 372/50.ccls. or 257/79.ccls. or 257/8$1.ccls. or 257/9$1.ccls. or 257/100.ccls. or 257/101.ccls. or 257/102.ccls. or 257/103.ccls.) and ((low or lower) near6 thermal near6 resistance near6 heat adj sink)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 10:46
–	19	(372/4$1.ccls. or 372/50.ccls. or 257/79.ccls. or 257/8$1.ccls. or 257/9$1.ccls. or 257/100.ccls. or 257/101.ccls. or 257/102.ccls. or 257/103.ccls.) and (thermal adj resistance near6 heat adj sink)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 10:49
–	1	thermal adj resistance near3 copper near12 "deg/W"	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 12:17
–	9	(thickness or thick) near4 heat adj sink and (257/$6.ccls. or 372/$6.ccls.) and (area near4 bonded)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 11:19

-	25	(US-5307362-$ or US-5373519-$ or US-5422905-$ or US-6448583-$ or US-6049423-$ or US-5105237-$ or US-5970081-$ or US-5734672-$ or US-6219364-$ or US-6049125-$ or US-5758951-$ or US-6133631-$ or US-6144684-$ or US-4829531-$ or US-5488678-$ or US-5825952-$ or US-5907571-$ or US-5355385-$).did. or (DE-4315581-$).did. or (JP-61176169-$ or JP-05129730-$).did. or (EP-257898-$ or JP-07045811-$ or JP-09127349-$ or EP-483549-$).did.	USPAT; EPO; JPO; DERWENT	2002/11/02 11:53
-	0	heat adj sink near12 "W/deg" and (laser or light-emtting or light adj emitting).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 12:18
-	0	heat adj sink near12 "W/deg" and (laser or light-emitting or light adj emitting).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 12:18
-	0	heat adj sink near12 "W/deg" and (257/$6.ccls. or 438/$6.ccls. or 372/$6.ccls.)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 12:19
-	193	heat adj sink near12 thermal adj resistance and (257/$6.ccls. or 438/$6.ccls. or 372/$6.ccls.)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 12:20
-	43	heat adj sink near12 thermal adj resistance near12 low and (257/$6.ccls. or 438/$6.ccls. or 372/$6.ccls.)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 12:36
-	1	heat adj sink near12 thermal adj resistance near12 low near12 (copper or cu) and (257/$6.ccls. or 438/$6.ccls. or 372/$6.ccls.)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 12:22
-	43	heat adj sink near12 thermal adj resistance near12 low and (257/$6.ccls. or 438/$6.ccls. or 372/$6.ccls.)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 12:23
-	0	heat adj sink near12 thermal adj resistance near12 low near12 "K/W" and (257/$6.ccls. or 438/$6.ccls. or 372/$6.ccls.)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 12:37
-	0	heat adj sink near12 thermal adj resistance near12 "K/W" and (257/$6.ccls. or 438/$6.ccls. or 372/$6.ccls.)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 12:38
-	0	heat adj sink near12 (copper or cu) near12 thermal adj resistance near12 "K/W"	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 12:39

-	27	(US-5825952-$ or US-6049125-$ or US-6219364-$ or US-6448583-$ or US-5422905-$ or US-5970081-$ or US-5734672-$ or US-6144684-$ or US-6133631-$ or US-5758951-$ or US-6049423-$ or US-4829531-$ or US-5488678-$ or US-4899210-$ or US-5373519-$ or US-5307362-$ or US-5105237-$ or US-5907571-$ or US-5355385-$ or US-5381859-$).did. or (DE-4315581-$).did. or (JP-61176169-$ or JP-05129730-$).did. or (JP-09127349-$ or EP-257898-$ or JP-07045811-$ or EP-483549-$).did.	USPAT; EPO; JPO; DERWENT	2002/11/02 13:46
-	2	monochromatic near12 laser adj diode adj array	USPAT; EPO; JPO; DERWENT	2002/11/02 13:47
-	5	laser adj diode adj array near12 "same wavelength"	USPAT; EPO; JPO; DERWENT	2002/11/02 17:01
-	4	(mqw or multiple adj quantum adj well) near6 different adj wavelength	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 18:59
-	2	("6049125").PN.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 19:32
-	2	("6049423").PN.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 19:37
-	14	(("6049423") or ("6049125") or ("5625402") or ("5422905") or ("5970081") or ("5355385") or ("5907571")).PN.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/11/02 19:37
-	7	(("6049423") or ("6049125") or ("5625402") or ("5422905") or ("5970081") or ("5355385") or ("5907571")).PN.	USPAT	2002/11/02 19:38
-	2	semiconductor.ti,ab,clm. and laser.ti,ab,clm. and resin near12 (mixture or mix or mixing or mixed) near12 diffusion	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/11 16:03
-	6	laser.ti,ab,clm. and resin near12 (mixture or mix or mixing or mixed) near12 diffusion	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/11 16:07
-	3	laser.ti,ab,clm. and (light-diffusing or light adj diffusing) near3 resin	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/11 16:08
-	6	laser.ti,ab,clm. and (light-diffusing or light adj diffusing) near5 resin	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/11 16:09

–	34	(US-5614338-$ or US-5530780-$ or US-5976175-$ or US-5307362-$ or US-5355385-$ or US-5105237-$ or US-5373519-$ or US-5970081-$ or US-6133631-$ or US-6144684-$ or US-5734672-$ or US-6448583-$ or US-5422905-$ or US-4899210-$ or US-5625402-$ or US-5758951-$ or US-6219364-$ or US-6049423-$ or US-5488678-$ or US-5825952-$ or US-4829531-$ or US-5907571-$ or US-6049125-$ or US-5381859-$).did. or (US-20030031917-$).did. or (DE-4315581-$).did. or (JP-04037487-$ or JP-61176169-$ or JP-05129730-$).did. or (GB-2142441-$ or JP-07045811-$ or JP-09127349-$ or EP-257898-$ or EP-483549-$).did.	USPAT; US-PGPUB; EPO; JPO; DERWENT	2003/04/13 17:38
–	18	(diffuse or diffusive) near12 resin and laser.ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT	2003/04/13 18:01
–	0	eye near12 protect$3 and laser.ti,ab,clm. and resin near12 diffus$3	USPAT; US-PGPUB; EPO; JPO; DERWENT	2003/04/13 18:03
–	0	eye near12 protect$3 and laser.ti,ab,clm. and resin near12 (light-diffus$3 or diffus$3)	USPAT; US-PGPUB; EPO; JPO; DERWENT	2003/04/13 18:03
–	156	laser.ti,ab,clm. and resin near12 (light-diffus$3 or diffus$3)	USPAT; US-PGPUB; EPO; JPO; DERWENT	2003/04/13 18:03
–	4	laser.ti,ab,clm. and resin near12 light-diffus$3	USPAT; US-PGPUB; EPO; JPO; DERWENT	2003/04/13 18:13
–	34	laser.ti,ab,clm. and resin near12 (light near5 diffus$3 or light-diffus$3)	USPAT; US-PGPUB; EPO; JPO; DERWENT	2003/04/13 18:21
–	115	semiconductor adj laser.ti,ab,clm. and resin near6 lens	USPAT; US-PGPUB; EPO; JPO; DERWENT	2003/04/13 18:25
–	62	semiconductor adj laser.ti,ab,clm. and resin near3 lens	USPAT; US-PGPUB; EPO; JPO; DERWENT	2003/04/13 18:25
–	0	semiconductor adj laser.ti,ab,clm. and light-diffus$3 near6 resin near3 lens	USPAT; US-PGPUB; EPO; JPO; DERWENT	2003/04/13 18:26
–	1	semiconductor adj laser.ti,ab,clm. and (light near3 diffus$3 or light-diffus$3) near6 resin near6 lens	USPAT; US-PGPUB; EPO; JPO; DERWENT	2003/04/13 18:28
–	1	semiconductor adj laser.ti,ab,clm. and (light near6 diffus$3 or light-diffus$3) near12 resin near6 lens	USPAT; US-PGPUB; EPO; JPO; DERWENT	2003/04/13 18:29
–	1	semiconductor.ti,ab,clm. and laser.ti,ab,clm. and (light near6 diffus$3 or light-diffus$3) near12 resin near6 lens	USPAT; US-PGPUB; EPO; JPO; DERWENT	2003/04/13 18:34
–	3	semiconductor.ti,ab,clm. and (light-emitting laser).ti,ab,clm. and (light near6 diffus$3 or light-diffus$3) near12 resin near6 lens	USPAT; US-PGPUB; EPO; JPO; DERWENT	2003/04/13 18:34

-	126	resin near6 lens and semiconductor adj2 laser.ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/14 10:18
-	66	resin near3 lens and semiconductor adj2 laser.ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/14 10:21
-	0	light-diffusive near6 resin near3 lens and semiconductor adj2 laser.ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/14 10:19
-	0	(light near6 (diffusive or diffusion or diffuse) or light-diffusive) near6 resin near3 lens and semiconductor adj2 laser.ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/14 10:20
-	0	(light near12 (diffusive or diffusion or diffuse) or light-diffusive) near12 resin near12 lens and semiconductor adj2 laser.ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/14 10:21
-	34	resin near2 lens and semiconductor adj2 laser.ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/14 10:22
-	0	molded near2 resin near2 lens and semiconductor adj2 laser.ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/14 10:22
-	7	molded near12 resin near2 lens and semiconductor adj2 laser.ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/14 10:28
-	2	laser.ti,ab,clm. and light-diffusive near6 resin	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/14 10:30
-	16	laser.ti,ab,clm. and (light near3 (diffusive or diffusion or diffuse) light-diffusive) near6 resin	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/14 10:31

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PAT-NO: JP407072311A

DOCUMENT-IDENTIFIER: JP 07072311 A

TITLE: LIGHT TRANSMITTING LENS OF LASER HRAD

PUBN-DATE: March 17, 1995

INVENTOR-INFORMATION:
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ASSIGNEE-INFORMATION:

NAME	COUNTRY
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KODEN ELECTRON CO LTD	N/A

APPL-NO: JP05245995

APPL-DATE: September 6, 1993

INT-CL (IPC): G02B003/06

ABSTRACT:

PURPOSE: To obtain the light transmitting lens which can be molded integrally out of transparent resin by injection and is thin by forming a plane-convex lens and a piano-convex cylindrical lens integrally out of the transparent resin by injection while making their flat surfaces common.

CONSTITUTION: This light transmitting lens has the plane-convex lens 1a and

plane-convex cylindrical lens 1b formed integrally of the transparent resin by injection while having their flat surfaces in common. Then longitudinal and lateral different spread angles of a light beam emitted from a semiconductor laser re compressed are by the plane-convex lens 1a at an equal rate longitudinally and laterally. For example, the lateral spread angle of the light beam whose compressibility by the plane-convex lens 1a is about 10° is set to a value which enables compression up to a target value of several degrees and the compression of the spread angle in the lateral direction is attained only by the plane-convex lens 1a. In this case, the longitudinal spread angle of about 30° larger than that in the lateral direction has a deficiency in compressibility by the plane-convex lens 1a compensated by only longitudinal compression by the plane-convex cylindrical lens 1b.

PAT-NO: JP407072311A

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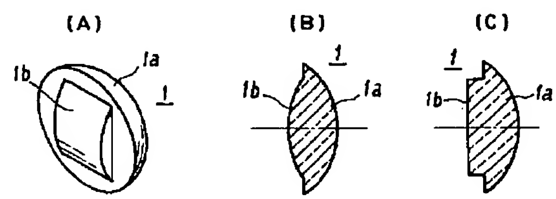
最終頁に続く

(54)【発明の名称】　レーザヘッドの送光レンズ

(57)【要約】

〔目的〕　透光性樹脂の射出成形による一体化などを可能とする厚みの小さなレーザヘッドの送光レンズを提供する。

〔構成〕　平凸レンズ(1a)と平凸円柱レンズ(1b)又は平凹円柱レンズとがそれぞれの平坦面を共通にしながら又は光軸方向に交差させながら透光性の樹脂を素材として射出成形により一体に形成されている。



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【特許請求の範囲】

【請求項１】平凸レンズと平凸円柱レンズとが、それぞれの平坦面を共通にしながら透光性の樹脂を素材として射出成形により一体に形成されたことを特徴とするレーザヘッドの送光レンズ。

【請求項２】平凸レンズと平凹円柱レンズとが、それぞれの平坦面を共通にしながら透光性の樹脂を素材として射出成形により一体に形成されたことを特徴とするレーザヘッドの送光レンズ。

【請求項３】平凸レンズと平凹円柱レンズとが、それぞれの平坦面を光軸方向に交差させながら透光性の樹脂を素材として射出成形により一体に形成されたことを特徴とするレーザヘッドの送光レンズ。

【請求項４】平凸レンズと平凸又は平凹円柱レンズが、それぞれの平坦面において接合されたことを特徴とするレーザヘッドの送光レンズ。

【請求項５】　請求項１又は４において、

前記円柱レンズの曲面の周辺部に光吸収層を形成する構成のスリットを備えたことを特徴とするレーザヘッドの送光レンズ。

【請求項６】　請求項１乃至５において、

前記レーザヘッドは、車載用レーザレーダのレーザヘッドであることを特徴とするレーザヘッドの送光レンズ。

【請求項７】　請求項６において、

前記レーザヘッドは、縦横比がほぼ１対２の照射面を前方に形成することを特徴とするレーザヘッドの送光レンズ。

【請求項８】凸レンズと円柱レンズとの組合せから成ることを特徴とするレーザヘッドの送光レンズ。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、車載用レーザレーダなどに利用されるレーザヘッドの送光レンズに関するものであり、特に、簡易・安価な送光レンズに関するものである。

【０００２】

【従来の技術】車載用レーダ装置の一つとしてレーザレーダが使用される。このレーザレーダは、半導体レーザダイオードと送光レンズから構成されるレーザヘッドから急峻なパルス状のレーザ光を放射し、先行車両などの標的で反射されて戻ってきた反射光をアバランシェ・ホトダイオードなどの受光素子を含む受光部で受け、レーザ光を放射してからその反射光を受けるまでに要した時間の半分をレーザ光の伝播速度（光速）で除算することにより標的までの距離を検出する構成となっている。

【０００３】上記レーザヘッドを構成する半導体レーザレーダについては、その発光面が極端に偏った縦横比の短冊形状を呈すると共に、数十度のビーム広がり角の前方指向性を有している。以下では、説明の便宜上、発光面の狭い幅の方向を縦方向、広い幅の方向を横方向と称

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することにすれば、典型的には、縦方向の幅は数μｍ程度であるのに対して、横方向の幅はその百倍程度の値の数百μｍ程度である。さらに特徴的な点は、このような半導体レーザダイオードでは、光ビームの広がり角が縦横各方向について顕著な差異を有する点である。すなわち、発光ビームの典型的な広がり角は、幅の狭い縦方向については３０°程度、幅の広い横方向については１０°程度の値になる。これに対して、所望の検知エリア、すなわち、レーザビームによる照射面の形状は、典型的には、１００ｍ程度の前方において、横幅が車線の幅程度の８ｍ程度、縦幅が車両の高さ程度の４ｍ程度と見積もられる。このような半導体レーザを光源として、縦横比１対２程度の横長の形状の照射面を１００ｍ程度の遠方にわたって形成するためには縦方向のビーム広がり角の圧縮率が横方向のそれよりも６倍程度大きな特殊な送光用光学系が必要になる。

【０００４】

【発明が解決しようとする課題】上述したような特殊な送光用光学系の候補の一つとして、図８に示すように、半導体レーザダイオードの前方に縦横比１対２程度の形状のスリットを配置し、光ビームのうち広がり角が１°～３°程度以下の部分のみを通過させる構成が考えられる。この構成によれば、極めて簡易・安価な送光用光学系を実現できる。しかしながら、このスリットのみを用いる送光用光学系では、光源からの発光量の大部分がスリットで反射、あるいは吸収されて無駄になってしまうため、標的に対する照射光量が著しく減少し、検出感度が著しく低下してしまうという問題がある。

【０００５】送光用光学系を凸レンズによって構成し光ビームの縦方向と横方向への広がり角を数度程度の値に圧縮する構成とすれば、発光量の有効利用が可能になり、スリットのみで構成する場合の欠点を解消できる。しかしながら、広がり角の所望の圧縮率が縦方向と横角方向とで６倍程度も異なるため、縦・横方向への異なる圧縮率を実現するための特殊な組合せレンズ系が必要になる。このような組合せレンズ系としては、図９（Ａ）に示すように、互いに異なる圧縮率でビームの広がり角を縦方向に圧縮する平凸円柱（シリンドリカル）レンズ５１と、横方向に圧縮する平凸円柱レンズ５２とを組合せることによって実現できる。

【０００６】図９（Ａ）のレンズ系の保持機構の簡易化を図るために、図９（Ｂ）に示すように、平凸円柱レンズ５１と５２の平坦面どうしを接着剤で接合することによって両者を一体化する構造が望ましい。更に、図９（Ｃ）に示すように、素材となる透光性の樹脂を射出成形することにより円柱レンズ５１と円柱レンズ５２とを一体に形成する構成とすれば、両レンズの接合面で生じるレーザ光の反射損失と剥離に伴う光学特性の劣化とを回避すると共に、組み立ての労力を軽減するうえで一層望ましい。

【0007】図9（C）に示した透光性の樹脂の射出成形による円柱レンズの一体構造は、上述した各種の利点がある。しかしながら、この一体構造では全体の厚みが増加し、この結果、高い形状精度の確保が困難になるという問題がある。まず、この一体構造の円柱レンズの厚みが増加する理由について説明する。図10（A）の斜視図に示すように平坦部分の厚みがゼロであり、かつ、説明の便宜上それぞれの焦点距離、すなわち曲面の曲率が等しい一体構造の円柱レンズを想定する。その光軸を通る縦断面図と横断面図は、それぞれ図 10 （B）と（C）とに示すようなものとなる。図10に示した一体構造の円柱レンズは、光ビームの広がり角の縦方向と横方向への圧縮倍率が等しいため、これを光学的に等価な平凸レンズに置換えることができる。このような光学的に等価な平凸レンズの斜視図、縦断面図及び横断面図は、図11の（A），（B）及び（C）に示すようなものとなる。

【0008】図10と図11の断面図を比較すれば、一体構造の円柱レンズの厚みは、これと光学的に等価な平凸レンズの厚みの２倍の値になることが判る。これは、平凸レンズの場合には光ビームの広がり角度を縦方向と横方向に圧縮するための各曲面が共通の空間内に形成されているのに対し、一体構造の円柱レンズの場合には上記各曲面が別個の空間内に形成されていることに起因する。これは、各曲面の曲率、従ってそれぞれの厚みが異なる実際の一体構造の円柱レンズについても共通する点である。

【0009】ところで、図10に示したような一体構造の円柱レンズを射出成形によって作成する場合、その厚みの増加と共に形状精度の確保が飛躍的に困難になる。以下、その理由について説明する。周知のように、射出成形は、高温で溶融状態となった樹脂を加圧状態で金型内に充填し、この充填物を冷却固化させることにより行われる。この冷却は、高温の樹脂から金型への放熱によって行われる。従って、金型と接触する樹脂の周辺部分の温度がまず低下し、この周辺部分から内部にむけて漸次冷却と固化が進行してゆくことになる。この冷却時の熱収縮に伴い樹脂内部に大きな熱応力と熱歪みとが発生し、最終的な形状精度の低下を招く。このような形状精度の低下は、固化しつつある樹脂の周辺部分と中心部分の温度差の増大につれて、すなわち、形状の異方性と厚みの増大とにつれて顕著になる。このように、形状の異方性が大きなレンズでは、その厚みが大きくなると、固化途中に生ずる熱歪みのため、曲面の形状精度が大幅に低下したり、甚だしい場合にはクラックが生じたりして実用的なレンズの形成が実質状不可能になるという問題がある。

【0010】従って、本発明の一つの目的は、透光性樹脂の射出成形による一体化などを可能とする厚みの小さなレーザヘッドの送光レンズを提供することにある。

【0011】

【課題を解決するための手段】上記従来技術の課題を解決する本発明のレーザヘッドの送光レンズは、平凸レンズと平凸又は平凹円柱レンズとが、それぞれの平坦面を共通にしながら、あるいは交差させながら透光性の樹脂を素材として射出成形により一体に形成されている。

【0012】

【作用】本発明によれば、半導体レーザから放射される光ビームの縦・横方向に異なる広がり角が平凸レンズによって縦方向と横方向に等しい倍率で圧縮される。例えば、上記平凸レンズによる圧縮率が光ビームの１０°程度の横方向への広がり角を数度程度の目標値まで圧縮できるような値に設定されており、横方向の広がり角の圧縮はこの平凸レンズのみにより達成される。この場合、横方向よりも大きな３０°程度の縦方向への広がり角については、上記平凸レンズのみによる圧縮率では不足しており、この圧縮率の不足分が平凸円柱レンズによる縦方向のみの圧縮によって補われる。他の一例によれば、上記平凸レンズによる圧縮率が光ビームの３０°程度の縦方向への広がり角を数度程度の目標値まで圧縮できるような値に設定されており、縦方向の広がり角の圧縮はこの平凸レンズのみにより達成される。この場合、縦方向よりも小さな１０°程度の横方向への広がり角については、上記平凸レンズのみによる圧縮率では過大であり、この圧縮率の過大分が平凹円柱レンズによる縦方向のみの広がり角の拡大によって補正され、最終的な数度程度の広がり角が得られる。

【0013】上記平凸又は平凹円柱レンズの曲面は、いずれも平凸レンズによる圧縮率の不足分や過大分を補正するためのものであることから、焦点距離の大きな（曲率の大きな）薄いもので足り、組合せレンズ全体の厚みが低減される。この結果、このような平凸レンズと円柱レンズとの組合せレンズを透光性の樹脂の射出成形によって必要な形状精度のもとでかつ歩留り良く一体化して作成することが可能になる。本発明の更に詳細については以下の実施例と共に説明する。

【0014】

【実施例】図１は、本発明の一実施例に係わるレーザヘッドの送光レンズの構成を示す斜視図（A）と断面図（B），（C）である。なお、（B）は光軸を含む垂直平面で切断した様子を示す縦断面図であり、（C）は光軸を含む垂直面で切断した様子を示す横断面図である。この送光レンズは、平凸レンズ１ａと、平凸円柱レンズ１ｂとが、それぞれの平坦面を共通にしながら透光性の樹脂を素材として射出成形により一体に形成されている。この実施例の送光レンズは、例えば、図５に示すような構成の車載用レーザレーダ装置を構成するレーザヘッドに組み込まれる。

【0015】半導体レーザから放射される光ビームの縦・横方向に異なる広がり角が平凸レンズ１ａによって縦

方向と横方向に等しい倍率で圧縮される。図5の使用例の場合、平凸レンズ１ａによる圧縮率が光ビームの１０°程度の横方向への広がり角を数度程度の目標値まで圧縮できるような値に設定されており、横方向の広がり角の圧縮はこの平凸レンズ１ａのみにより達成される。この場合、横方向よりも大きな３０°程度の縦方向への広がり角については、平凸レンズ１ａのみによる圧縮率では不足しており、この圧縮率の不足分が平凸円柱レンズ１ｂによる縦方向のみの圧縮によって補われる。

【００１６】図2は、本発明の他の実施例に係わるレーザヘッドの送光レンズの構成を示す斜視図（Ａ）、縦断面図（Ｂ）及び横断面図（Ｃ）である。この送光レンズは、平凸レンズ１ａと、平凹円柱レンズ１ｂ’とが、それぞれの平坦面を共通にしながら透光性の樹脂を素材として射出成形により一体に形成されている。この実施例の送光レンズは、例えば、図５に示すような構成の車載用レーザレーダ装置を構成するレーザヘッドに組み込まれる。

【００１７】図２の実施例によれば、平凸レンズ１ａによる圧縮率が光ビームの３０°程度の縦方向への広がり角を数度程度の目標値まで圧縮できるような値に設定されており、縦方向の広がり角の圧縮はこの平凸レンズ１ａのみにより達成される。この場合、縦方向よりも小さな１０°程度の横方向への広がり角については、平凸レンズ１ａのみによる圧縮率では過大であり、この圧縮率の過大分が平凹円柱レンズ１ｂ’による縦方向のみの広がり角の拡大によって補正され、最終的な数度程度の広がり角が得られる。

【００１８】図3は、本発明の更に他の実施例に係わるレーザヘッドの送光レンズの構成を示す斜視図（Ａ）、縦断面図（Ｂ）及び横断面図（Ｃ）である。この送光レンズは、平凸レンズ１ａと、平凹円柱レンズ１ｂ’とが、それぞれの平坦面α，βを光軸方向に交差させながら透光性の樹脂を素材として射出成形により一体に形成されている。この実施例によれば、組合せレンズの厚みが極小となる。この送光レンズの光学的作用は、上述した図２の場合と同一である。

【００１９】図4は、本発明の更に他の実施例に係わるレーザヘッドの送光レンズの構成を示す斜視図（Ａ）、縦断面図（Ｂ）及び横断面図（Ｃ）である。この送光レンズは、平凸レンズ１ａと、平凸円柱レンズ１ｂとが、それぞれの平坦面を共通にしながら透光性の樹脂を素材として射出成形により一体に形成される共に、平凸円柱レンズ１ｂの曲面の周辺部にスクリーン印刷により光吸収層を形成する構成のスリットを備えている。前述のように、平凸円柱レンズ１ｂは補正用であることからその曲面の湾曲は緩やかであり、その結果、曲面上へのスクリーン印刷が容易かつ確実に行える。

【００２０】図5は、図4に示した一体化送光レンズ１を利用する車載レーザレーダ装置のレーザヘッドの主要部分の構成を示す断面図である。平凸レンズ１ａと平凸円柱レンズ１ｂとから成る一体化送光レンズ１が内部レンズホルダ２内に保持され、この内部レンズホルダ２が外部レンズホルダ３内に保持される。この外部レンズホルダ3は、フレーム４によって保持される。内部レンズホルダ２は外部レンズホルダ３の内部において光軸方向に前後できるように保持されており、最終位置が止めネジ6によって確定される。外部レンズホルダ３の前方には保護ガラス５が配置される。送光レンズ１の後方には、プリント配線板８に搭載されたケース入りの半導体レーザダイオード７が配置される。

【００２１】次に、図５のレーザヘッドの設計の一例について説明する。半導体レーザダイオードのビームの広がり角が垂直方向には30°、水平方向には10°であるとし、これらの広がり角を垂直方向にはほぼ 1.7°、水平方向にはほぼ 2.7°に圧縮することにより、縦横比ほぼ１対２の横長の照射面をヘッドの前方に形成するものとする。なお、以下で説明する設計例は、既に多数回にわたる試行錯誤を経た最終段階のものであり、各種の定数や変数の値の決定については相前後する場合を含んでいる。

【００２２】まず、垂直方向へのビームの成形について説明することとし、平凸レンズと平凸円柱レンズ単体と、それぞれを合成した送光レンズについて図６に示すような各定数や変数を定義する。

f_1　：平凸レンズの焦点距離（ 40 mmとする）

f_2　：平凸円柱レンズの焦点距離（ 120　mmとする）

ａ　：平凸レンズの第２主点から発光面までの距離（ 33 mmとする）

ｄ　：平凸レンズの第２主点から平凸円柱レンズの第１主点までの距離（ 8.1　mmとする）

ｔ　：平凸円柱レンズの第１主点からその第２主点までの距離（1.5 mmとする）

ｚ　：平凸円柱レンズの第２主点から合成レンズの第２主点までの距離

ｆ　：合成後の送光レンズの焦点距離

ａ’　：合成後の送光レンズの第２主点から発光面までの距離

ｂ’　：合成後の送光レンズの第２主点から発光面の虚像までの距離

θ_v　：光ビームの垂直方向への広がり角の半角（30°/2=15°）

θ_v’：合成後の送光レンズを通過した光ビームの広がり角(半角)

【００２３】各レンズ単体の焦点距離f_1，f_2と合成レンズの焦点距離ｆとの関係式に、f_1 = 40 mm、f_2 = 140　mm、ｄ= 8.1　mm　を代入すると、合成焦点距離ｆとして、

$$f=(f_1\cdot f_2)/(f_1+f_2-d) \quad \cdots (1)$$
$$=(40\cdot 120)/(40+120-8.1)$$
$$=31.6\ \mathrm{mm}$$

を得る。次に、平凸円柱レンズの第2主点から合成レンズの第2主点までの距離zとして、

$$z=f-f_2(f_1-d)/(f_1+f_2-d) \quad \cdots (2)$$
$$=31.6-120(40-8.1)/(40+120-8.1)$$
$$=6.4\ \mathrm{mm}$$

を得る。

【0024】平凸レンズの第2主点から発光面までの距離aを 33 mm、平凸円柱レンズの第1主点からその第2主点までの距離tを 1.5 mmとすると、合成後の送光レンズの第2主点から発光面までの距離a'として、

$$a'=a-d+z-t \quad \cdots (3)$$
$$=33-8.1+6.4-1.5$$
$$=29.8\ \mathrm{mm}$$

を得る。

【0025】合成後の送光レンズの焦点距離f、半導体レーザダイオードの発光面の位置及び光ビームの広がり角に関しては次の式が成り立つ。

$$1/f=1/a'-1/b' \quad \cdots (4)$$
$$b'/a'=\tan\theta_v/\tan\theta_v' \quad \cdots (5)$$

(4)式、(5)式からb'を消去し、f＝31.6mm、a'＝29.8mm，θ_v＝ 15° を代入すると、

$2\theta_v'=1.74°$

となり、目標値1.74° にほぼ等しい垂直方向への光ビームの広がり角が得られる。

【0026】次に、水平方向へのビームの成形について説明することとし、平凸レンズと平凸円柱レンズ単体と、それぞれを合成した送光レンズについて図7に示すような各定数や変数を定義する。

F_1 ：平凸レンズの焦点距離（ 40 mm）

F_2 ：平凸円柱レンズの焦点距離（理論的には無限大であるが計算の便宜上これを10^5 mmとする）

A ：平凸レンズの第2主点から発光面までの距離（ 33 mm）

D ：平凸レンズの第2主点から平凸円柱レンズの第1主点までの距離（ 5.5 mmとする）

T ：平凸円柱レンズの第1主点からその第2主点までの距離（ 4mmとする）

Z ：平凸円柱レンズの第2主点から合成レンズの第2主点までの距離

F ：合成後の送光レンズの焦点距離

A' ：合成後の送光レンズの第2主点から発光面までの距離

B' ：合成後の送光レンズの第2主点から発光面の虚像までの距離

θ_H ：光ビームの水平方向への広がり角の半角（10°/2＝ 5°）

θ_H' ：合成後の送光レンズを通過した光ビームの広がり角（半角）

W_H ：スリットの幅

【0027】各レンズ単体の焦点距離F_1，F_2 と合成レンズの焦点距離Fとの関係式に、F_1 ＝ 40 mm、F_2 ＝10^5 mm、D＝ 5.5 mm を代入すると、合成焦点距離Fとして、

$$F=(F_1\cdot F_2)/(F_1+F_2-D) \quad \cdots (6)$$
$$=(40\cdot 10^5)/(40+10^5-5.5)$$
$$=40\ \mathrm{mm}$$

を得る。次に、平凸円柱レンズの第2主点から合成レンズの第2主点までの距離Zとして、

$$Z=F-F_2(F_1-D)/(F_1+F_2-D) \quad \cdots (7)$$
$$=40-10^5(40-5.5)/(40+10^5-5.5)$$
$$=5.5\ \mathrm{mm}$$

を得る。

【0028】平凸レンズの第2主点から発光面までの距離Aを 33 mm、平凸円柱レンズの第1主点からその第2主点までの距離Tを 4 mmとすると、合成後の送光レンズの第2主点から発光面までの距離A'として、

$$A'=A-D+Z-T \quad \cdots (8)$$
$$=33-5.5+5.5-4$$
$$=29\ \mathrm{mm}$$

を得る。

【0029】合成後の送光レンズの焦点距離F、半導体レーザダイオードの発光面の位置及び光ビームの広がり角に関しては次の式が成り立つ。

$$1/F=1/A'-1/B' \quad \cdots (9)$$

$$B'/A' = \tan\theta_H / \tan\theta_H' \quad \cdots (10)$$

（9）式、（10）式からB'を消去し、F＝40 mm、A'＝29 mm，θ_H＝5°を代入すると、

$2\theta_H' = 2.74°$ ＊

＊となり、目標値 2.7° にほぼ等しい垂直方向への光ビームの広がり角が得られる。

【0030】また、スリットの幅W_Hとして、

$$W_H = 2(A-D-T)\tan\theta_H \quad \cdots (11)$$
$$= 2(33 - 5.5 - 4)\tan 5°$$
$$= 4.1\ \mathrm{mm}$$

を得る。

【0031】以上、平凸レンズと円柱レンズとを透光性の樹脂を素材として射出成形により一体に作成する場合を例示した。しかしながら、平凸レンズと円柱レンズのそれぞれを透光性の樹脂やガラスで個別に作成し、両者の平坦面を接着剤などで接合する構成とすることもできる。

【0032】また、車載レーザレーダ装置用のレーザヘッドに適用する場合を例示した。しかしながら、本発明の送光レンズを適用するレーザヘッドは、光学的読み取装置の対物レンズに所望断面形状を有するほぼ平行なレーザ光線を供給するためのものなど他の適宜なものであってもよいことは明らかである。

【0033】

【発明の効果】以上詳細に説明したように、本発明に係わるレーザヘッドの送光レンズによれば、平凸レンズと平凸又は平凹円柱レンズとが、それぞれの平坦面を共通にしながら、あるいは交差させながら透光性の樹脂を素材として射出成形により一体に形成される構成であるから、厚みが減少し、射出成形によっても高い形状精度の一体化レンズを歩留り良く製作できるという効果が奏される。

【図面の簡単な説明】

【図１】本発明の一実施例に係わるレーザヘッドの送光レンズの構成を示す斜視図（Ａ）、横断面図（Ｂ）及び縦断面図（Ｃ）である。

【図２】本発明の他の実施例に係わるレーザヘッドの送光レンズの構成を示す斜視図（Ａ）、横断面図（Ｂ）及び縦断面図（Ｃ）である。

【図３】本発明の更に他の実施例に係わるレーザヘッド※

※の送光レンズの構成を示す斜視図（Ａ）、横断面図（Ｂ）及び縦断面図（Ｃ）である。

【図４】本発明の更に他の実施例に係わるレーザヘッドの送光レンズの構成を示す斜視図（Ａ）、横断面図（Ｂ）及び縦断面図（Ｃ）である。

【図５】図４の送光レンズを用いたレーザヘッドの構成の一例を示す断面図である。

【図６】図５のレーザヘッドによる垂直方向への光ビームの広がり角の圧縮に関する設計の一例を説明する断面図である。

【図７】図５のレーザヘッドによる水平方向への光ビームの広がり角の圧縮に関する設計の一例を説明する断面図である。

【図８】スリットのみで構成するレーザヘッドの送光光学系の構成の一例を説明するための斜視図である。

【図９】２個の円柱レンズの組合せによって構成するレーザヘッドの送光レンズ系の構成の一例を説明するための斜視図である。

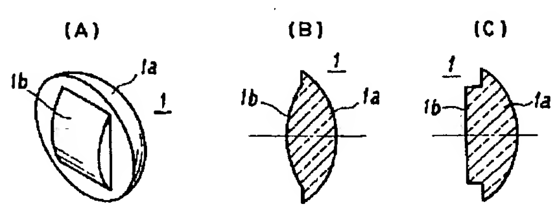
【図10】２個の円柱レンズを組合せて構成する送光レンズ系の厚みを説明するための斜視図である。

【図11】平凸レンズで構成する送光レンズ系の厚みを、２個の円柱レンズの組合せの場合と比較して説明するための斜視図である。

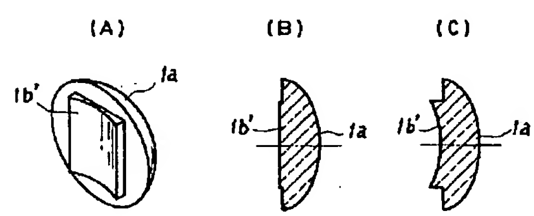
【符号の説明】

1　レンズヘッドの送光レンズ
1ａ　平凸レンズ
1ｂ　平凸円柱レンズ
1ｂ'　平凸円柱レンズ
1ｃ　スリット

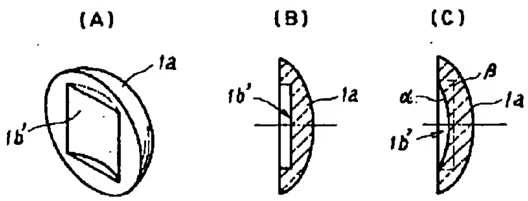
【図１】



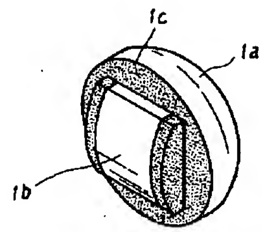
【図２】



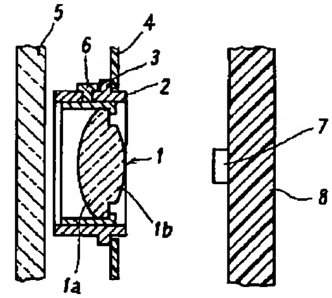
【図3】



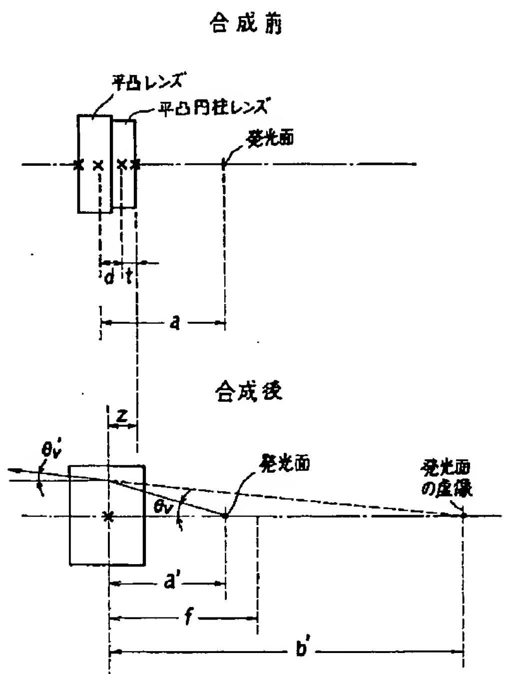
【図4】



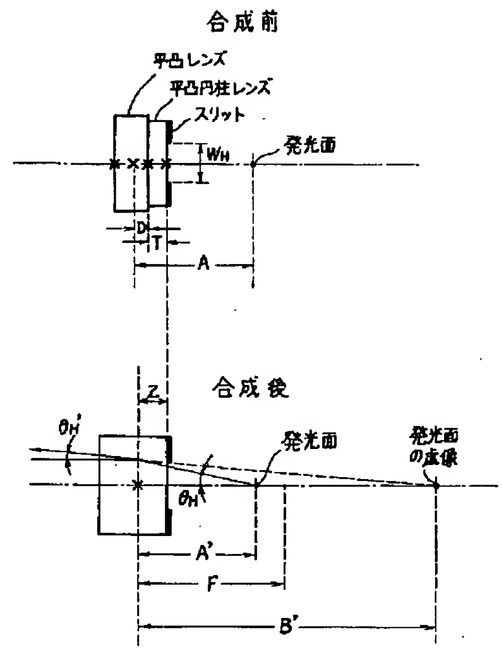
【図5】



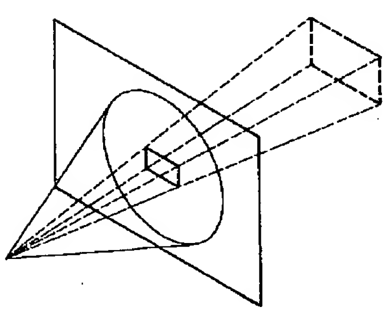
【図6】



【図7】



【図8】



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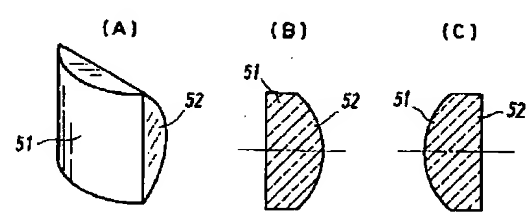

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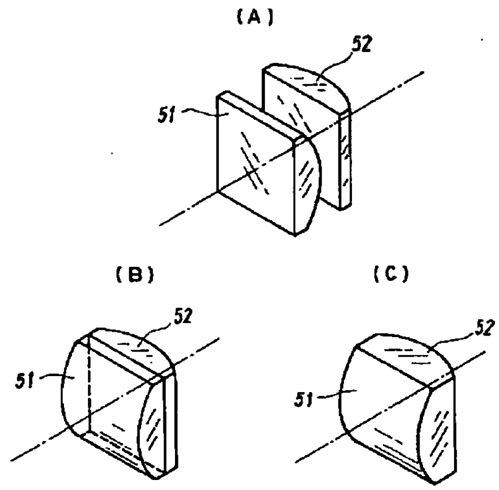

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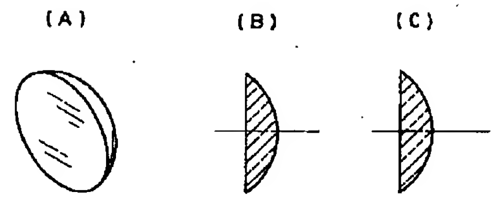

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【補正内容】
【図４】本発明の更に他の実施例に係わるレーザヘッドの送光レンズの構成を示す斜視図である

フロントページの続き

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* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to a simple and cheap light transmission lens especially about the light transmission lens of the laser head used for the laser radar for mount etc.
[0002]
[Description of the Prior Art] A laser radar is used as one of the radar installations for mount. This laser radar emits the laser beam of the shape of a steep pulse from the laser head which consists of a semiconductor laser diode and a light transmission lens, receives the reflected light which was reflected by targets, such as precedence vehicles, and has returned in the light-receiving section containing photo detectors, such as an avalanche photo-diode, and has the composition of detecting the distance to a target, by carrying out the division of the half of the time taken [after emitting a laser beam] to receive the reflected light by the propagation velocity (velocity of light) of a laser beam.
[0003] About the semiconductor laser radar which constitutes the above-mentioned laser head, while the luminescence side presents the shape of a rectangle of the aspect ratio toward which it inclined extremely, it has the front directivity of the beam divergence angle of dozens of times. Below, if the direction of width of face with a luminescence side narrow for convenience of explanation is made to call a longitudinal direction lengthwise and the direction of latus width of face, typically, lateral width of face will be about hundreds of micrometers of the about 100-time value to lengthwise width of face being about several micrometers. A still more characteristic point is a point of having a difference with the angle of divergence of a light beam remarkable about every direction each direction, in such semiconductor laser diode. That is, the typical angle of divergence of a luminescence beam is 30o about lengthwise [with narrow width of face]. About a grade and the latus longitudinal direction of width of face, it is 10o. It becomes the value of a grade. On the other hand, typically in the about [100m] front, about [that breadth is the width-of-face grade of a lane] 8m, and a dip estimate the configuration of desired detection area, i.e., the irradiation side by the laser beam, at about [about / of vehicles / height] 4m. By using such semiconductor laser as the light source, in order to form the irradiation side of a with an aspect ratio of about 1 to 2 oblong configuration over an about [100m] distant place, the special optical system for light transmission with the compressibility of a lengthwise beam divergence angle bigger about 6 times than lateral it is needed.
[0004]
[Problem(s) to be Solved by the Invention] As one of the candidates of special optical system for light transmission which was mentioned above, as shown in drawing 8 , the slit of a with an aspect ratio of about 1 to 2 configuration is arranged ahead of semiconductor laser diode, and the composition which an angle of divergence makes pass only the portion not more than about 1o -3 degree among light beams can be considered. According to this composition, the very simple and cheap optical system for light transmission is realizable. However, in the optical system for light transmission only using this slit, since most amounts of luminescence from the light source are reflected or absorbed and it becomes useless to a slit, the irradiation quantity of light to a target decreases remarkably, and there is a problem

that detection sensitivity will fall remarkably.

[0005] The composition which constitutes the optical system for light transmission with a convex lens, and compresses the angle of divergence to lengthwise and the longitudinal direction of a light beam into the value about abundance, then a deployment of the amount of luminescence are attained, and the fault in the case of constituting only from a slit can be canceled. However, since lengthwise differs in the compressibility of a request of an angle of divergence about 6 times from the direction of a horizontal angle, the special combination lens system for realizing different compressibility to the in-every-direction direction is needed. As such a combination lens system, as shown in drawing 9 (A), it is realizable by combining the planoconvex pillar (cylindrical) lens 51 which compresses the divergence angle of beams into lengthwise, and the planoconvex cylindrical lens 52 compressed into a longitudinal direction with mutually different compressibility.

[0006] In order to attain simplification of the maintenance mechanism of the lens system of drawing 9 (A), as shown in drawing 9 (B), the structure which unifies both is desirable by joining the flat sides of the planoconvex cylindrical lenses 51 and 52 with adhesives. Furthermore, as shown in drawing 9 (C), while avoiding the reflection loss of the composition which forms a cylindrical lens 51 and a cylindrical lens 52 in one by carrying out injection molding of the resin of a translucency used as a material, then the laser beam produced in the plane of composition of both lenses, and degradation of the optical property accompanying ablation, when mitigating the effort of an assembly, it is much more desirable.

[0007] The integral construction of the cylindrical lens by injection molding of the resin of a translucency shown in drawing 9 (C) has various kinds of advantages mentioned above. However, in this integral construction, the whole thickness increases, consequently there is a problem that reservation of a high configuration precision becomes difficult. First, the reason which the thickness of the cylindrical lens of this integral construction increases is explained. As shown in the perspective diagram of drawing 10 (A), the thickness for a flat part is zero, and each focal distance, i.e., the curvature of a curved surface, assumes the cylindrical lens of equal integral construction on [of explanation] expedient. Drawing of longitudinal section and the cross-sectional view which pass along the optical axis are drawing, respectively. 10 It seems that it is indicated in (C) as (B). Since the cylindrical lens of the integral construction shown in drawing 10 has the equal compression scale factor to lengthwise and the longitudinal direction of an angle of divergence of a light beam, it can transpose this to an equivalent plano-convex lens optically. The perspective diagram, drawing of longitudinal section, and the cross-sectional view of an equivalent plano-convex lens become such a thing as shown in (A) of drawing 11, (B), and (C) optically.

[0008] If the cross section of drawing 10 and drawing 11 is compared, as for the thickness of the cylindrical lens of integral construction, the value of the double precision of the thickness of an equivalent plano-convex lens understands a bird clapper as this optically. This originates in being formed in the space where each above-mentioned curved surface is separate in the case of the cylindrical lens of integral construction to each curved surface for compressing the degree of angle of divergence of a light beam at lengthwise and a longitudinal direction in the case of a plano-convex lens being formed in common space. This is a point which is common also about the cylindrical lens of actual integral construction with which the curvature of each curved surface therefore differs from each thickness.

[0009] By the way, when creating the cylindrical lens of integral construction as shown in drawing 10 with injection molding, reservation of configuration precision becomes difficult by leaps and bounds with the increase in the thickness. Hereafter, the reason is explained. the resin with which injection molding changed into the melting state at the elevated temperature as everyone knows -- a pressurization state -- metal mold -- it is filled up inside and carried out by carrying out cooling solidification of this packing This cooling is performed by the heat dissipation to metal mold from a hot resin. Therefore, the temperature for a periphery of the resin in contact with metal mold will fall first, and cooling and solidification will advance gradually towards this interior of a periphery part shell. In connection with the thermal contraction at the time of this cooling, big thermal stress and heat distortion occur and the fall of a final configuration precision is invited to the interior of a resin. The fall of such a configuration precision becomes remarkable along with the anisotropy of a configuration, and increase of thickness

along with the solidified increase of the temperature gradient for a part for the periphery of a resin, and a core. Thus, with a lens with the big anisotropy of a configuration, when the thickness becomes large, there is a problem that the configuration precision of a curved surface falls sharply, or a crack arises in being excessive, and the shape of substance of formation of a practical lens becomes impossible, for heat distortion produced in the middle of solidification.

[0010] Therefore, one purpose of this invention is to offer the light transmission lens of a laser head with the small thickness which enables the unification by injection molding of a translucency resin etc.

[0011]

[Means for Solving the Problem] The light transmission lens of the laser head of this invention which solves the technical problem of the above-mentioned conventional technology is formed [while a plano-convex lens, planoconvex, or a **** cylindrical lens carries out each flat side in common, or] in one by injection molding by being made from the resin of a translucency, making it cross.

[0012]

[Function] According to this invention, a different angle of divergence in the in-every-direction direction of the light beam emitted from semiconductor laser is compressed for a scale factor equal to lengthwise and a longitudinal direction by the plano-convex lens. For example, the compressibility by the above-mentioned plano-convex lens is 10o of a light beam. It is set as the value which can compress the angle of divergence to the longitudinal direction which is a grade to the desired value about abundance, and compression of a lateral angle of divergence is attained by only this plano-convex lens. In this case, bigger 30o than a longitudinal direction About the lengthwise angle of divergence of a grade, with the compressibility only by the above-mentioned plano-convex lens, it runs short and the insufficiency of this compressibility is compensated by compression lengthwise [by the planoconvex cylindrical lens]. The compressibility [according to other examples] by the above-mentioned plano-convex lens is 30o of a light beam. It is set as the value which can compress the lengthwise angle of divergence which is a grade to the desired value about abundance, and compression of a lengthwise angle of divergence is attained by only this plano-convex lens. In this case, 10o smaller than lengthwise About the angle of divergence to the longitudinal direction of a grade, with the compressibility only by the above-mentioned plano-convex lens, it is excessive, fault Oita of this compressibility is rectified by expansion of an angle of divergence lengthwise [by the **** cylindrical lens], and the angle of divergence about [final] abundance is obtained.

[0013] It has been what has a focal distance big (curvature is big) since each curved surface of the above-mentioned planoconvex or a **** cylindrical lens is the thing of an amendment sake about the insufficiency of compressibility and fault Oita by the plano-convex lens thin enough, and the thickness of the whole combination lens is reduced. Consequently, it becomes possible to unify with the yield to be the basis of a required configuration precision and sufficient, and to create the combination lens of such a plano-convex lens and a cylindrical lens with injection molding of the resin of a translucency. For details, it explains with the following examples of this invention further.

[0014]

[Example] Drawing 1 is the perspective diagram (A) showing the composition of the light transmission lens of the laser head concerning one example of this invention, a cross section (B), and (C). In addition, (B) is drawing of longitudinal section showing signs that it cut at the perpendicular flat surface containing an optical axis, and (C) is the cross-sectional view showing signs that it cut by the vertical plane containing an optical axis. This light transmission lens is formed in one by injection molding by being made from the resin of a translucency, while plano-convex lens 1a and planoconvex cylindrical-lens 1b carry out each flat side in common. The light transmission lens of this example is built into the laser head which constitutes the laser radar equipment for mount of composition as shown in drawing 5 .

[0015] A different angle of divergence in the in-every-direction direction of the light beam emitted from semiconductor laser is compressed by plano-convex lens 1a for a scale factor equal to lengthwise and a longitudinal direction. The compressibility according to plano-convex lens 1a the case of the example of use of drawing 5 is 10o of a light beam. It is set as the value which can compress the angle of divergence

to the longitudinal direction which is a grade to the desired value about abundance, and compression of a lateral angle of divergence is attained by only this plano-convex lens 1a. In this case, bigger 30o than a longitudinal direction About the lengthwise angle of divergence of a grade, with the compressibility only by plano-convex lens 1a, it runs short and the insufficiency of this compressibility is compensated by compression lengthwise [by planoconvex cylindrical-lens 1b].

[0016] Drawing 2 is the perspective diagram (A), drawing of longitudinal section (B), and the cross-sectional view (C) showing the composition of the light transmission lens of the laser head concerning other examples of this invention. This light transmission lens is formed in one by injection molding by being made from the resin of a translucency, while plano-convex lens 1a and **** cylindrical-lens 1b' carry out each flat side in common. The light transmission lens of this example is built into the laser head which constitutes the laser radar equipment for mount of composition as shown in drawing 5 .

[0017] The compressibility [according to the example of drawing 2] by plano-convex lens 1a is 30o of a light beam. It is set as the value which can compress the lengthwise angle of divergence which is a grade to the desired value about abundance, and compression of a lengthwise angle of divergence is attained by only this plano-convex lens 1a. In this case, 10o smaller than lengthwise About the angle of divergence to the longitudinal direction of a grade, with the compressibility only by plano-convex lens 1a, it is excessive, fault Oita of this compressibility is rectified by expansion of an angle of divergence lengthwise [by **** cylindrical-lens 1b'], and the angle of divergence about [final] abundance is obtained.

[0018] Drawing 3 is the perspective diagram (A), drawing of longitudinal section (B), and the cross-sectional view (C) showing the composition of the light transmission lens of the laser head concerning the example of further others of this invention. This light transmission lens is formed in one by injection molding by being made from the resin of a translucency, while plano-convex lens 1a and **** cylindrical-lens 1b' make each flat side alpha and beta cross in the direction of an optical axis. According to this example, the thickness of a combination lens serves as the minimum. The optical operation of this light transmission lens is the same as that of the case of drawing 2 mentioned above.

[0019] Drawing 4 is the perspective diagram (A), drawing of longitudinal section (B), and the cross-sectional view (C) showing the composition of the light transmission lens of the laser head concerning the example of further others of this invention. This light transmission lens is equipped with the slit of the composition of being formed in one by injection molding by being made from the resin of a translucency, while plano-convex lens 1a and planoconvex cylindrical-lens 1b carry out each flat side in common which both forms an optical-absorption layer in the periphery of the curved surface of planoconvex cylindrical-lens 1b by screen-stencil. As mentioned above, since planoconvex cylindrical-lens 1b is an object for an amendment, screen-stencil of a up to [a curved surface] can ensure [easily and] the curve of the curved surface gently consequently.

[0020] Drawing 5 is the cross section showing the composition of the main portions of the laser head using the unification light transmission lens 1 shown in drawing 4 of mounted laser radar equipment. The unification light transmission lens 1 which consists of plano-convex lens 1a and planoconvex cylindrical-lens 1b is held in the internal lens holder 2, and this internal lens holder 2 is held in the external lens holder 3. This external lens holder 3 is held by the frame 4. The internal lens holder 2 is held so that it can do in the direction of an optical axis in the interior of the external lens holder 3 approximately, and the last position stops it and it is decided with a screw 6. Cover glass 5 is arranged ahead of the external lens holder 3. Behind the light transmission lens 1, the semiconductor laser diode 7 of entering [which was carried in the printed wired board 8] a case is arranged.

[0021] Next, an example of a design of the laser head of drawing 5 is explained. the divergence angle of beams of semiconductor laser diode -- a perpendicular direction -- 30o -- horizontal -- 10o it is -- ** -- carrying out -- these angles of divergence -- a perpendicular direction -- almost -- 1.7 o -- horizontal -- almost -- By compressing into 2.7 o, the oblong irradiation side of an aspect ratio about 1 to 2 shall be formed ahead of a head. In addition, the example of a design explained below is the thing of the culmination which already passed through the trial and error covering many times, and includes the case where it gets mixed up, about the determination of the value of various kinds of constants or a variable.

[0022] First, it supposes that fabrication of the beam to a perpendicular direction is explained, and each constant and a variable as shown in drawing 6 about a plano-convex lens, a planoconvex cylindrical-lens simple substance, and the light transmission lens that compounded each are defined.
f1 : Focal distance of a plano-convex lens (referred to as 40 mm)
f2 : Focal distance of a planoconvex cylindrical lens (referred to as 120 mm)
: distance d from the 2nd principal point of a plano-convex lens to a luminescence side (referred to as 33 mm) : Distance from the 2nd principal point of a plano-convex lens to the 1st principal point of a planoconvex cylindrical lens (referred to as 8.1 mm)
t : distance from the 1st principal point of a planoconvex cylindrical lens to the 2nd principal point (referred to as 1.5 mm)
z : half size of the angle of divergence to the perpendicular direction of the distance f light beam from the 2nd principal point of a planoconvex cylindrical lens to the 2nd principal point of a synthetic lens : Focal distance a' of the light transmission lens after composition : Distance b' from the 2nd principal point of the light transmission lens after composition to a luminescence side : Distance thetav from the 2nd principal point of the light transmission lens after composition to the virtual image of a luminescence side : (30degree/2=15o)
thetav': The angle of divergence of the light beam which passed the light transmission lens after composition (half size) [0023] The focal distance f1 of each lens simple substance, and f2 To relational expression with the focal distance f of a synthetic lens, it is f1 = 40 mm and f2 = 140. mm, d= 8.1 mm When it substitutes, it is as a synthetic focal distance f. f=(f1 and f2)/(f1+f2-d) ... (1)
= (40 , 120) /(40+120-8.1) = 31.6 mm is obtained. Next, it is a distance z from the 2nd principal point of a planoconvex cylindrical lens to the 2nd principal point of a synthetic lens. z=f-f2/(f1-d) (f1+f2-d) ... (2)
= 31.6-120/(40-8.1) (40+120-8.1) =6.4 mm is obtained.
[0024] Distance a from the 2nd principal point of a plano-convex lens to a luminescence side Distance t from the 1st principal point of 33 mm and a planoconvex cylindrical lens to the 2nd principal point 1.5 When mm, it is a'=a-d+z-t as distance a' from the 2nd principal point of the light transmission lens after composition to a luminescence side. ... (3)
= 33-8.1+6.4-1.5 = 29.8 mm is obtained.
[0025] The following formula is realized about the position of the focal distance f of the light transmission lens after composition, and the luminescence side of semiconductor laser diode, and the angle of divergence of a light beam.
1/f=1/a' - 1/b' ... (4)
b'/a' =tan thetav/ tan thetav' ... (5)
(4) Eliminate b' from a formula and (5) formulas and they are f= 31.6mm, a'=29.8mm, and thetav= 15 o. If it substitutes, it is set to 2thetav'=1.74o and is desired value 1.74o. The angle of divergence of the light beam to an almost equal perpendicular direction is obtained.
[0026] Next, it supposes that fabrication of the beam to a horizontal direction is explained, and each constant and a variable as shown in drawing 7 about a plano-convex lens, a planoconvex cylindrical-lens simple substance, and the light transmission lens that compounded each are defined.
F1 : Focal distance of a plano-convex lens (40 mm)
F2 : Focal distance of a planoconvex cylindrical lens (although it is theoretically infinite, this is set to 105 mm on [of calculation] expedient)
A : distance from the 2nd principal point of a plano-convex lens to a luminescence side (33 mm)
D : distance from the 2nd principal point of a plano-convex lens to the 1st principal point of a planoconvex cylindrical lens (referred to as 5.5 mm)
T : distance from the 1st principal point of a planoconvex cylindrical lens to the 2nd principal point (referred to as 4 mm)
Z Distance F from the 2nd principal point of :planoconvex cylindrical lens to the 2nd principal point of a synthetic lens : half size of the angle of divergence to the horizontal direction of a light beam : Focal distance A' of the light transmission lens after composition : Distance B' from the 2nd principal point of

the light transmission lens after composition to a luminescence side : Distance thetaH from the 2nd principal point of the light transmission lens after composition to the virtual image of a luminescence side (10 degrees / 2= 5o)
thetaH': Angle of divergence WH of the light beam which passed the light transmission lens after composition (half size) : Width of face of a slit [0027] The focal distance F1 of each lens simple substance, and F2 To relational expression with the focal distance F of a synthetic lens, it is F1 = 40 mm, F2 =105 mm, and D= 5.5. mm When it substitutes, it is as a synthetic focal distance F. F=(F1 and F2)/(F1+F2-D) ... (6)
= (40 and 105) /(40+105-5.5) = 40 mm is obtained. Next, it is a distance Z from the 2nd principal point of a planoconvex cylindrical lens to the 2nd principal point of a synthetic lens. Z=F-F2/(F1-D) (F1+F2-D) ... (7)
= 40-105(40-5.5)/(40+105-5.5) =5.5 mm is obtained.
[0028] Distance A from the 2nd principal point of a plano-convex lens to a luminescence side Distance T from the 1st principal point of 33 mm and a planoconvex cylindrical lens to the 2nd principal point 4 When mm, it is A'=A-D+Z-T as distance A' from the 2nd principal point of the light transmission lens after composition to a luminescence side. ... (8)
= 33-5.5+5.5-4 = 29 mm is obtained.
[0029] The following formula is realized about the position of the focal distance F of the light transmission lens after composition, and the luminescence side of semiconductor laser diode, and the angle of divergence of a light beam.
1-/F-1/A' - 1/B' ... (9)
B'/A' =tan thetaH/ tan thetaH' ... (10)
(9) When B' is eliminated from a formula and (10) formulas and F= 40 mm, A'= 29 mm, and thetaH= 5 o are substituted, it is set to 2thetaH'=2.74o and is desired value. 2.7o The angle of divergence of the light beam to an almost equal perpendicular direction is obtained.
[0030] Moreover, width of face WH of a slit It carries out. WH =2(A-D-T) tan thetaH ... (11) =2 (33 - 5.5-4) tan 5o = 4.1 mm is obtained.
[0031] As mentioned above, the case where a plano-convex lens and a cylindrical lens were created to one with injection molding by being made from the resin of a translucency was illustrated. However, each of a plano-convex lens and a cylindrical lens can be individually created with the resin and glass of a translucency, and both flat side can also be considered as the composition joined with adhesives etc.
[0032] Moreover, the case where it applied to the laser head for mounted laser radar equipments was illustrated. However, the laser head of things [, such as a thing for supplying the almost parallel laser beam which has a request cross-section configuration in the objective lens of optical reading ******,] others may be [things] proper which applies the light transmission lens of this invention is clear.
[0033]
[Effect of the Invention] Since a plano-convex lens, a planoconvex, or a **** cylindrical lens is [while carrying out each flat side in common, or] the composition formed in one by injection molding by being made from the resin of a translucency according to the light transmission lens of the laser head concerning this invention, making it cross as explained to the detail above, thickness decreases and the effect that the unification lens of a high configuration precision can manufacture with the sufficient yield also with injection molding is done so.

[Translation done.]

* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective diagram (A), the cross-sectional view (B), and drawing of longitudinal section (C) showing the composition of the light transmission lens of the laser head concerning one example of this invention.
[Drawing 2] It is the perspective diagram (A), the cross-sectional view (B), and drawing of longitudinal section (C) showing the composition of the light transmission lens of the laser head concerning other examples of this invention.
[Drawing 3] It is the perspective diagram (A), the cross-sectional view (B), and drawing of longitudinal section (C) showing the composition of the light transmission lens of the laser head concerning the example of further others of this invention.
[Drawing 4] It is the perspective diagram (A), the cross-sectional view (B), and drawing of longitudinal section (C) showing the composition of the light transmission lens of the laser head concerning the example of further others of this invention.
[Drawing 5] It is the cross section showing an example of the composition of the laser head using the light transmission lens of drawing 4 .
[Drawing 6] It is a cross section explaining an example of the design about compression of the angle of divergence of the light beam to the perpendicular direction by the laser head of drawing 5 .
[Drawing 7] It is a cross section explaining an example of the design about compression of the angle of divergence of the light beam to the horizontal direction by the laser head of drawing 5 .
[Drawing 8] It is a perspective diagram for explaining an example of the composition of the light transmission optical system of the laser head constituted only from a slit.
[Drawing 9] It is a perspective diagram for explaining an example of the composition of the light transmission lens system of the laser head constituted with the combination of two cylindrical lenses.
[Drawing 10] It is a perspective diagram for explaining the thickness of the light transmission lens system constituted combining two cylindrical lenses.
[Drawing 11] It is a perspective diagram for explaining the thickness of the light transmission lens system constituted from a plano-convex lens as compared with the case of the combination of two cylindrical lenses.
[Description of Notations]
1 Light Transmission Lens of Lens Head
1a Plano-convex lens
1b Planoconvex cylindrical lens
1b' Planoconvex cylindrical lens
1c Slit

[Translation done.]